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### Data-driven Assessment of Energy Efficiency Investment Behaviors of Midwest Residential Homeowners

#### OBJECTIVES:

The goal of this project is to assess the investment behaviors of residential homeowners in energy efficient technologies and retrofits including:

- HVAC Equipment
- Lighting
- Large Appliances
- Insulation

How many energy efficiency investments do homeowners make?

What energy efficient investments are the most common? Which are made first?

How much does a home owner typically pay for upgrades?

#### BACKGROUND:

In the United States, buildings account for a significant amount of the following, over half of which is from residential buildings:

- 39 % of total energy use
- 74 % of total electricity consumption
- 38 % of the carbon dioxide emissions

There is an established “**energy efficiency gap**” between possible savings and actual realized savings in buildings

Utility companies offer rebate programs to incentive energy savings retrofits. However often these programs are not fully taken advantage of

A better understanding of the energy efficiency investment behaviors of homeowners can provide insights into how to better motivate homeowners

#### METHODOLOGY:

Collaborative partnership between **Iowa State University** and **Cedar Falls Utilities** for the city of Cedar Falls

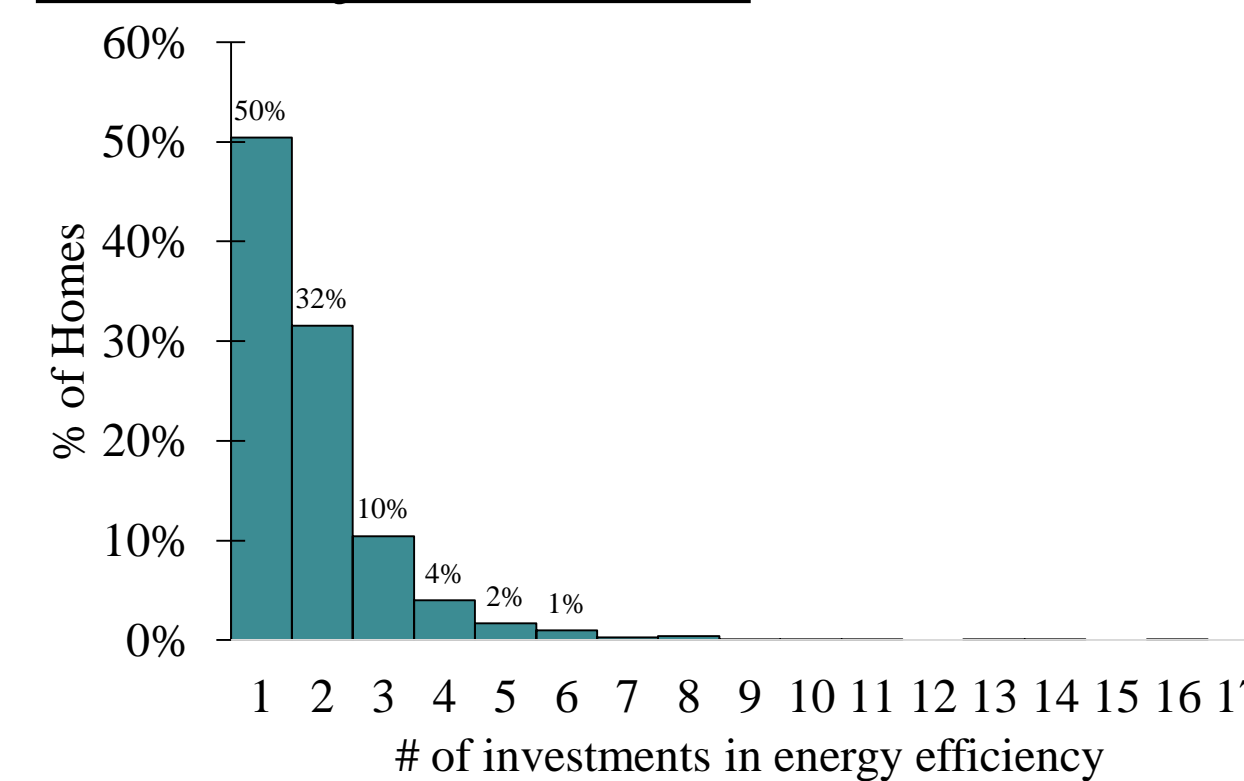
- 1) Collection of rebate data from 2009-2016 for all residential buildings in Cedar Falls, IA: 4000+ unique investments
- 2) Data anonymization and cleaning completed
- 3) Analysis of energy efficiency investments



#### PRELIMINARY RESULTS

Homeowners appear to find out about energy efficiency investments and rebates when large, essential equipment fails (e.g. HVAC) and need to make a large investment to fix; this leads to investments in other energy efficient technologies

##### Number of investments



82% of homes invest in 1-2 energy efficient features

Top 2% invest in 6+ energy efficient features

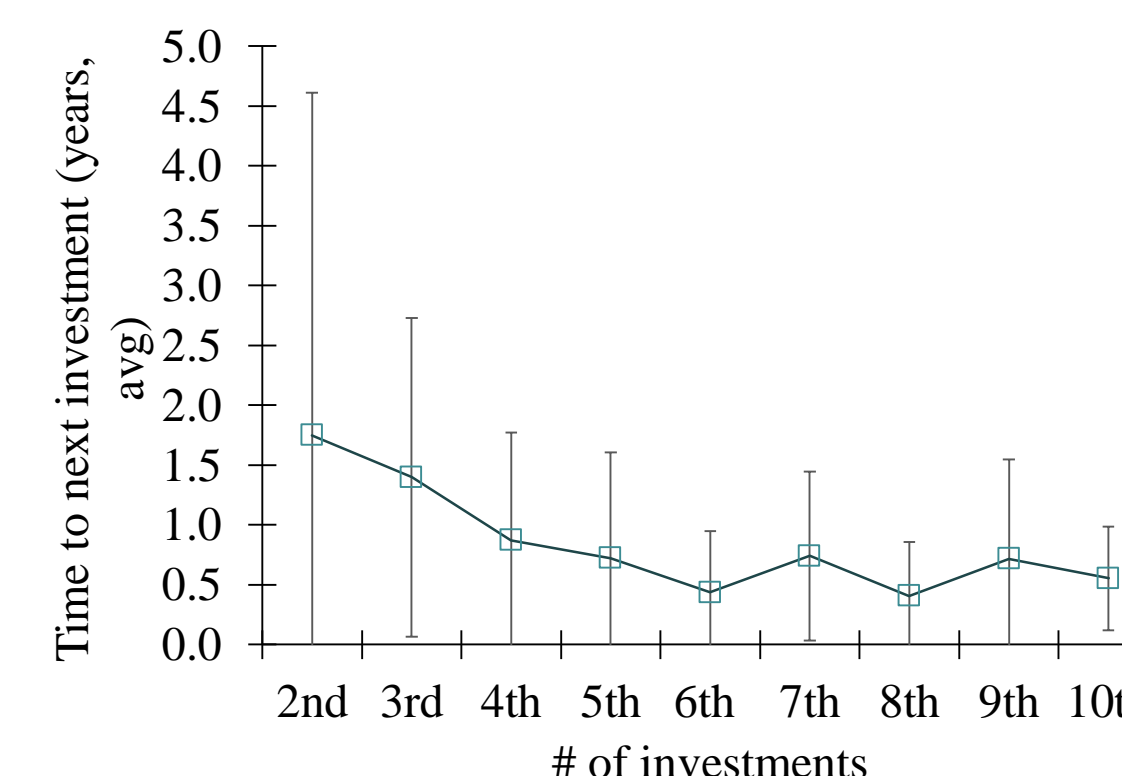
Top 1% invest in 7+ energy efficient features

##### Time to Invest

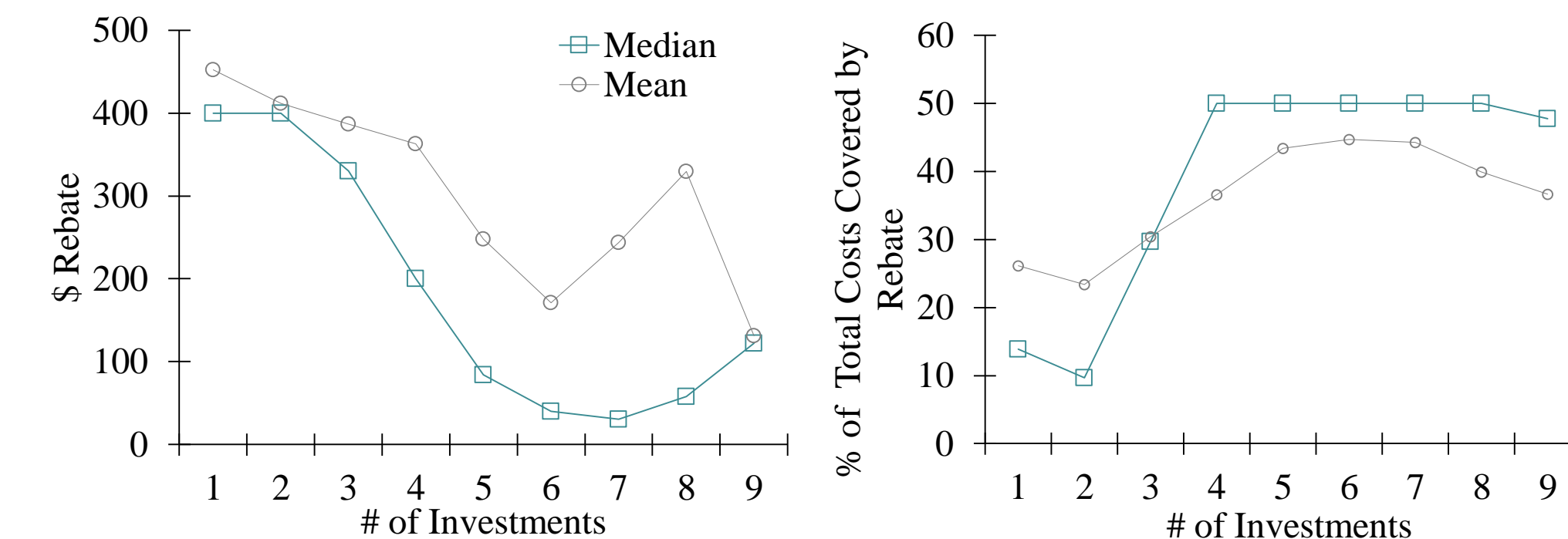
After the first investment, the average time to make another investment is 1.75 years

As more investments are made, the time between investment **decreases**

After the 6<sup>th</sup> investment, all next investments are about 0.5 years apart



#### Costs to Homeowners vs. Amount of Rebate



The **first** investment on average has the **largest incentive** but a relatively lower percent of cost covered (i.e. larger \$\$ items)

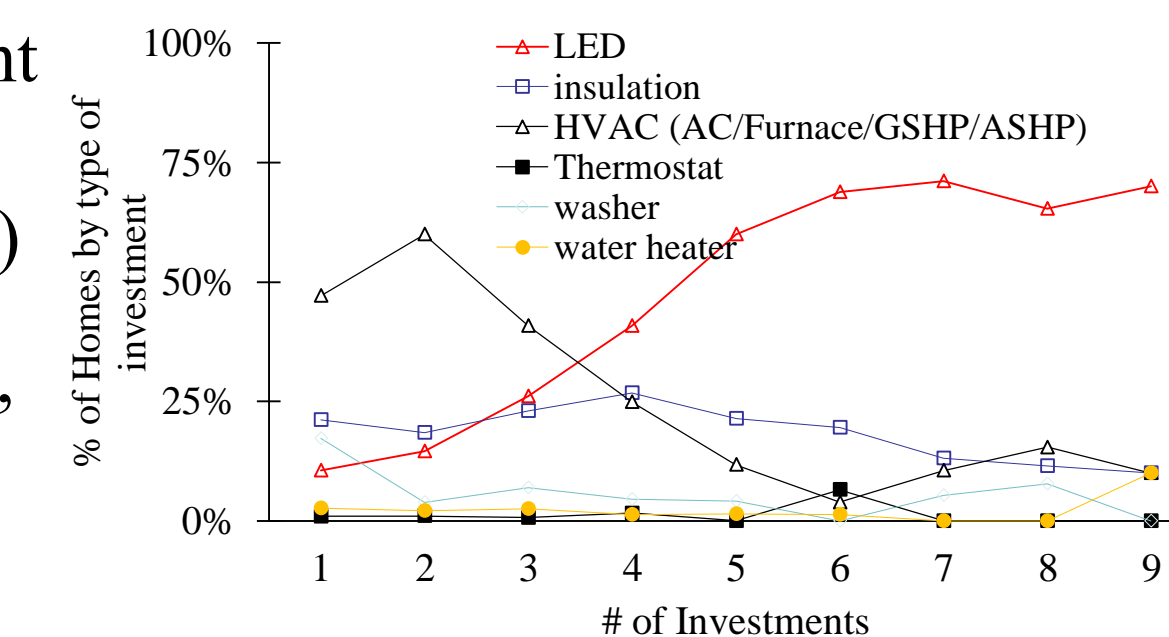
The **second** investment is the **most expensive** & owner must pay the largest percentage

The lower cost items are invested in **after** larger investments

#### Types of Energy Efficient Investments

1<sup>st</sup> and/or 2<sup>nd</sup> investment is most commonly an **HVAC** system (47-60%)

After the 4<sup>th</sup> investment, the lower costs **LEDs** are most common



#### CURRENT STATUS & WHAT'S NEXT?

How to encourage more energy efficiency investments?

- Study homeowners preferences : Why have homeowners made/not made energy efficient investments
- Why is HVAC the first energy efficient investment?
- What is the Willingness to Pay for efficient investments?
- Characterization of homes/homeowners who have made investments
- Realized vs. estimated savings; cost/benefit analysis